

PCTWORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : A01D 34/73, 34/67	A1	(11) International Publication Number: WO 96/24242
		(43) International Publication Date: 15 August 1996 (15.08.96)

(21) International Application Number: PCT/BE96/00012

(22) International Filing Date: 9 February 1996 (09.02.96)

(30) Priority Data:

9500108

10 February 1995 (10.02.95)

BE

(71) Applicant (for all designated States except US): SOLAR AND ROBOTICS S.A. [BE/BE]; Avenue de Fré 263, Boite postale 50, B-1180 Bruxelles (BE).

(72) Inventor; and

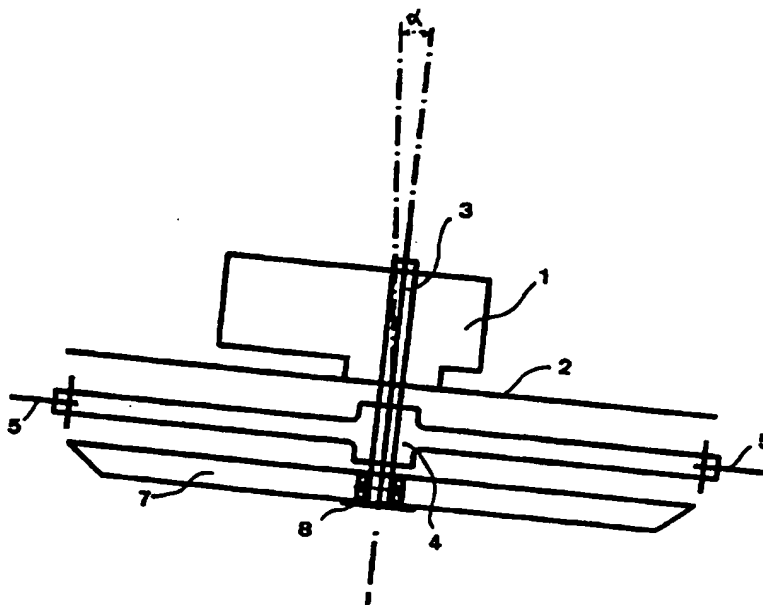
(75) Inventor/Applicant (for US only): COLENS, André [BE/BE]; Rue Baillois 5, B-1330 Rixensart (BE).

(74) Agent: COLENS, Alain; Bureau Colens S.P.R.L., Rue Franz Merjay 21, B-1050 Bruxelles (BE).

(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AZ, BY, KG, KZ, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published*With international search report.**Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.*

(54) Title: SELF CLEANING CUTTING HEAD FOR MOWERS



(57) Abstract

The invention relates to a cutting head, more particularly for a lawnmower with a rechargeable battery, comprising an electric motor (1) with a driving shaft (3) connected to a cutting disk (4) perpendicular to said shaft (3). The cutting disk (4) is provided with at least one blade (5) at its periphery. There is also provided a lower plate (7) parallel to and located under said cutting disk (4). The lower plate (7) is free wheeling around the axis through the use of a roller bearing (8). In the case of friction or jamming due to debris, the lower plate (7) starts to rotate to expel the debris by centrifugal effect.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	KZ	Kazakhstan	SG	Singapore
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovakia
CM	Cameroon	LR	Liberia	SN	Senegal
CN	China	LT	Lithuania	SZ	Swaziland
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

Self cleaning cutting head for mowers.

5

The present invention relates to a self-cleaning cutting head and a lawnmower adapted with such head, more particularly a low consumption robotic lawnmower powered by an electric motor.

10

Lawnmowers with rechargeable batteries are designed in order to run with a minimum power. The cutting device must be adapted to this primary need. It is more particularly the case for mowers which are entirely robotic, with
15 unattended operation, such as the ones described in the international patent application PCT/BE91/00068.

20

Traditional cutting systems perform the cutting operation under a cover, the cut grass being carried along by the rotating system. The ensuing result is that an important part of the energy is wasted during the cutting operation in order to transfer a kinetic energy to the cut grass which is dragged away by the cutting blade.

25

The cutting head usually used in robotic machines with a rechargeable battery is most often made of a lower plate, essentially circular, assembled to an upper plate by attaching flanges in such a way that a narrow space is left between the two plates.

0

-2-

A cutting disk is located between such plates and fixedly attached to a vertically extending output shaft from an electric motor. The cutting disk comprises preferably at least two retractable blades on its periphery, each of them
5 pivoting around a shaft located on said periphery and capable of returning between said plates.

When the cutting disk starts to rotate, driven by the electric motor, the blades extend due to the centrifugal
10 force and protrude out from both fixed plates in order to perform the grass cutting operation.

The rotating part in contact with the grass is then dramatically reduced and this arrangement decreases
15 substantially the friction on the surface to be mowed, the carrying along or drawing away of the grass by the rotating system and the aerodynamic turbulences.

The use of such lower static plate entails however some
20 problems.

In spite of the centrifugal effect due to the rotating disk, grass debris may on the long run and more particularly in wet weather, adhere to the internal face of
25 the lower plate resulting in a braking effect with concomitant increase of energy consumption.

A low energy consumption is a vital criterion for an efficient performance of an electric lawnmower, more
0 particularly a robotic mower with rechargeable battery.

5 In particular, for such an autonomous lawnmower with a battery which is rechargeable by induction at a fixed station, it is important than the search for this fixed station according to a predetermined algorithm (such as disclosed in patent application PCT/BE95/00013) be performed with a minimum energy consumption. For this purpose, the rotating cutting disk is disabled and will not operate during the searching step.

10 The lower plate acts then as a crumb scoop and scrapes the surface to be mowed with ensuing penetration of earth, twigs or dead leave debris between the plates. This may create a problem when the cutting disk has to be restarted.

15 The purpose of the present invention is to overcome the above mentioned disadvantages.

20 According to the invention, there is provided a cutting head comprising a cutting disk and at least one lower circular plate, preferably of similar dimension, wherein the static lower plate of the prior art is replaced by a mobile plate freely fixed at the end of the rotating shaft of the driving motor, for example by using a rolling bearing such a ball bearing a sliding bearing or a roller bearing.

25

0 The lower plate, in normal operation, which replaces the static lower plate of the prior art, is in contact with the grass of the surface to be mowed and do not rotate, or only slightly.

-4-

This construction provides a simultaneous absence of friction between the rotating cutting disk and to decrease the aerodynamic friction.

5 If debris becomes stuck between the lower plate and the cutting disk, the cutting disk will drag along the lower plate when the rotation starts at the beginning of a grass cutting operation, together with the debris which are then ejected by the rapid rotating movement. The rotating speed
10 (for example 2,500 rotations per minute) is indeed of such an amplitude that no debris will remain between the cutting disk and the lower plate. The cutting head performs therefore as a self-cleaning cutting head.

15 The accompanying drawing given by way of example is a view in cross-sectional elevation of a device according to the invention,

The device comprises a motor 1 fixed to the chassis (not shown), possibly through an upper supporting plate 2. The
20 motor is equipped with a shaft 3 at the end of which a cutting disk with retractable blades 5 is fixedly mounted.

At the free end of the shaft, a lower circular plate 7 is
25 mounted, which may freely rotate, through the use of a ball bearing 8. The plate 7 is parallel to the cutting disk and separated by a distance of p.e. 5 to 10 mm.

Advantageously, the cutting head may be mounted slightly
0 inclined forward in relation to the direction of movement of the mower such that there is a tilt angle of a few degrees between the spin axis and the perpendicular to the

horizontal plane (the plane of the grass to be cut). Preferably the angle is between 4 and 10°, still preferably about 7°. The rear of the plates and cutting disk are therefore upswept and elevated over the mowed surface with
5 no contact with the grass. According to this particular arrangement, the cutting blades will not touch again the grass at the rear of the cutting head, that is to say at a point opposite to the cutting operation, avoiding in this manner an additional energy consumption of poor efficiency.

10 This feature of the invention may also be applied independently to a cutting head of the prior art mower machine, with or without a lower plate.

15 The foregoing is considered as illustrative only of the principles of the invention. Since numerous modifications and changes will readily occur to those skilled in the art it is not desired to limit the invention to the exact construction and operation shown and described and
20 accordingly, all suitable modifications and equivalents may be resorted to falling within the scope of the invention.

25

0

Claims :

- 5 1. A cutting head for mowers, more particularly lawnmowers, comprising a motor and an output shaft which is connected to a cutting disk located perpendicularly to such shaft, said cutting disk comprising at its periphery at least one blade, said cutting head comprising also a lower plate
10 parallel to and located under the cutting disk characterised in that the lower plate is mounted in a free-rotating arrangement on said shaft by providing a roller bearing or equivalent means.
- 15 2. Cutting head according to claim 1 characterised in that the roller bearing is a ball bearing.
- 20 3. Cutting head according to claims 1 or 2 characterised in that the peripheral blades are retractable towards the rotation axis.
- 25 4. Cutting head according to any of the preceding claims characterised in that the rotation axis is inclined forwards relative to the direction of movement of the cutting head mounted in the mower.
5. Lawnmower provided with a cutting head according to claims 1 to 4.
- 0 6. Lawnmower according to claim 5 characterised in that the motor is an electric motor supplied by a rechargeable battery.

7. Lawnmower according to claim 5 or 6 characterised in that it is a autonomous robotic lawnmower.

5 8. Lawnmower according to claim 7 characterised in that the battery is recharged by induction at a fixed station.

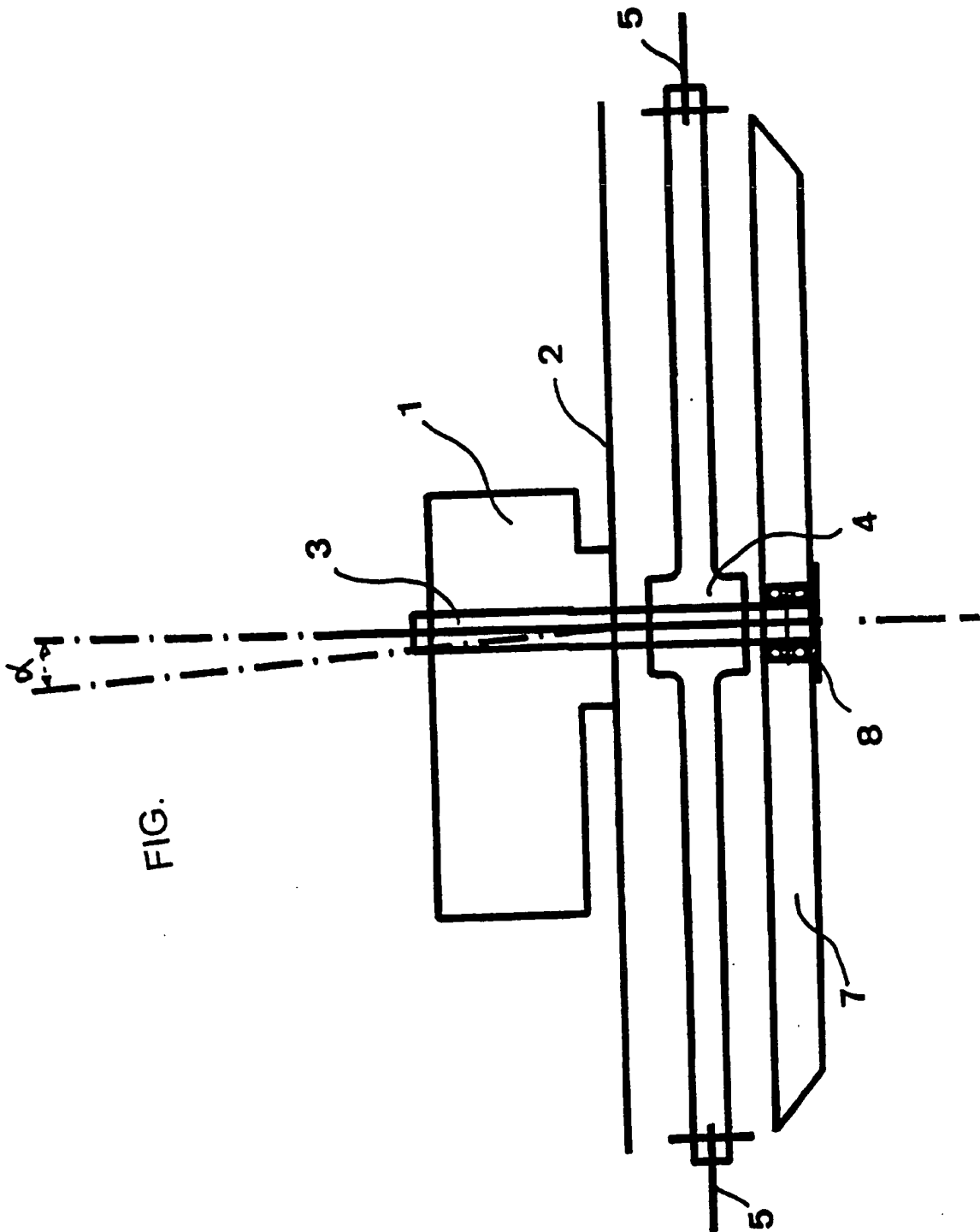
10

15

20

25

0



INTERNATIONAL SEARCH REPORT

International application No
PCT/BE 96/00012

A. CLASSIFICATION OF SUBJECT MATTER

A 01 D 34/73, A 01 D 34/67

According to International Patent Classification (IPC) or to both national classification and IPC⁶

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A 01 D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE, A, 4 021 496 (CLAAS SAULGAU GMBH) 09 January 1992 (09.01.92), column 1 lines 7ff; fig. 2,4	1, 2
A	column 1 lines 7ff; fig. 2,4.	4
X	DE, A, 2 537 698 (JOSEF BAUTZ GMBH) 03 March 1977 (03.03.77), page 4, lines 6-25; fig. 1,2.	1, 3
A	US, A, 4 703 613 (RAYMOND) 03 November 1987 (03.11.87), fig. 1,3.	1, 4, 5, 6
A	EP, A, 0 215 416	1, 2, 4

☒ Further documents are listed in the continuation of box C.

☐ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

A document member of the same patent family

Date of the actual completion of the international search
10 June 1996

Date of mailing of the international search report

19. 07. 96

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax (+31-70) 340-3016

Authorized officer

SCHNEEMANN e.h.

INTERNATIONAL SEARCH REPORT

-2-

International Application No
PCT/BE 96/00012

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>(TODESCO, ANDREINA) 25 March 1987 (25.03.87), column 3, lines 46ff; fig. 2. --</p> <p>WO, A, 92/04 817 (COLENS, ANDRE) 02 April 1992 (02.04.92), page 21, lines 8ff; fig. 4 (cited in the application). ----</p>	1,7

ANHANG

zum internationalen Recherchen-
bericht über die internationale
Patentanmeldung Nr.

ANNEX

to the International Search
Report to the International Patent
Application No.

ANNEXE

au rapport de recherche inter-
national relatif à la demande de brevet
international n°

PCT/BE 96/00012 SAE 12B439

In diesem Anhang sind die Mitglieder
der Patentfamilien der in obenge-
nannten internationalen Recherchenbericht
angeführten Patentdokumente angegeben.
Diese Angaben dienen nur zur Unter-
richtung und erfolgen ohne Gewähr.

This Annex lists the patent family
members relating to the patent documents
cited in the above-mentioned inter-
national search report. The Office is
in no way liable for these particulars
which are given merely for the purpose
of information.

La présente annexe indique les
membres de la famille de brevets
relatifs aux documents de brevets cités
dans le rapport de recherche inter-
national visée ci-dessus. Les renseigne-
ments fournis sont donnés à titre indica-
tif et n'engagent pas la responsabilité
de l'Office.

In Recherchenbericht angeführtes Patentdokument Patent document cited in search report Document de brevet cité dans le rapport de recherche	Datum der Veröffentlichung Publication date Date de publication	Mitglied(er) der Patentfamilie Patent family member(s) Membre(s) de la famille de brevets	Datum der Veröffentlichung Publication date Date de publication
DE A1 4021496	09-01-92	EP A1 465790	15-01-92
DE A1 2537698	03-03-77	keine - none - rien	
US A 4703613	03-11-87	CA A1 1247866	03-01-89
		GB A0 8629137	14-01-87
		GB A1 2183981	17-06-87
		GB B2 2183981	11-10-89
EP A1 215416		keine - none - rien	
WO A1 9204817	02-04-92	AU A1 84961791	15-04-92
		AU B2 653958	20-10-94
		BE AD 1003540	14-04-92
		BR A 9106874	20-07-93
		CA AA 2092294	25-03-93
		EP A1 550473	14-07-93
		FI A0 931294	23-03-93
		FI A 931294	19-05-93
		JP T2 6502528	24-03-94
		NO A0 9310600	23-03-93
		NO A 9310600	19-05-93
		US A 5444965	29-08-95
		BE AG 1004248	20-10-92

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

**As rescanning documents *will not* correct images,
please do not report the images to the
Image Problems Mailbox.**